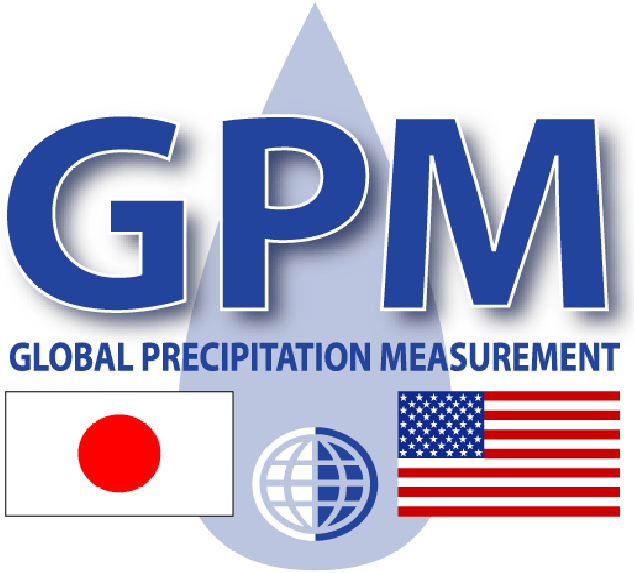
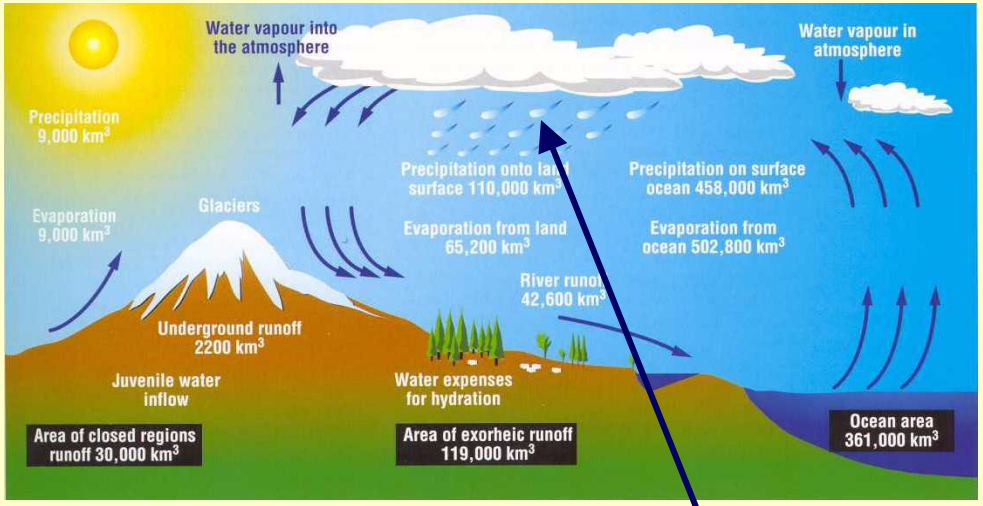


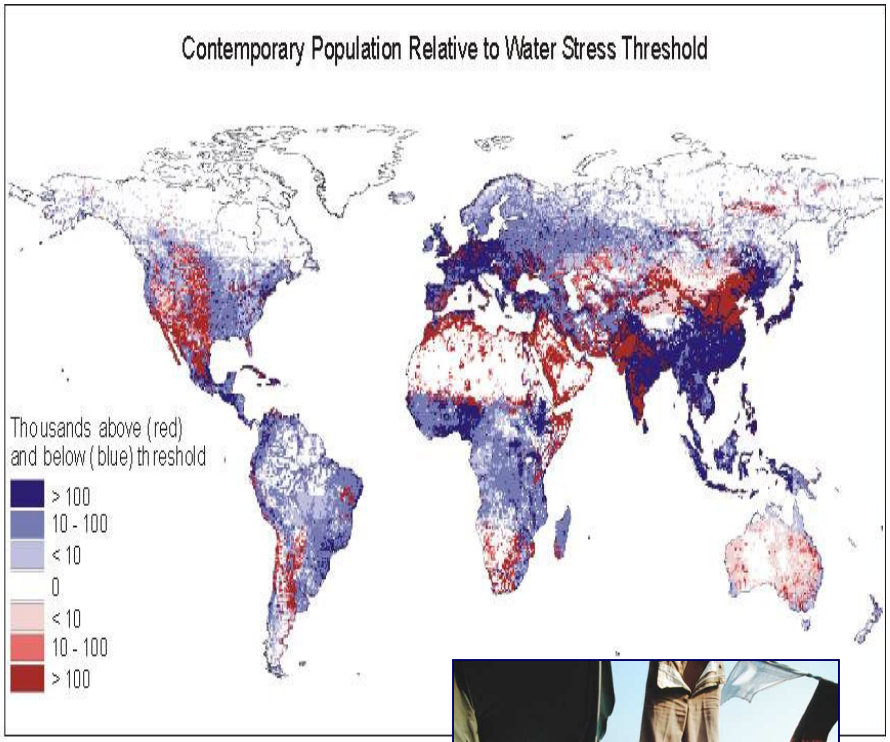
Dr. J. Marshall Shepherd
Deputy Project Scientist, GPM
Research Meteorologist

Developing International Partnerships to Understand The Global Water and Energy Cycle and Its Impact on Mankind



Accurate global precipitation measurement is required for better prediction of freshwater resources, climate change , weather, and the water cycle because *precipitation* is a key process that links them all….

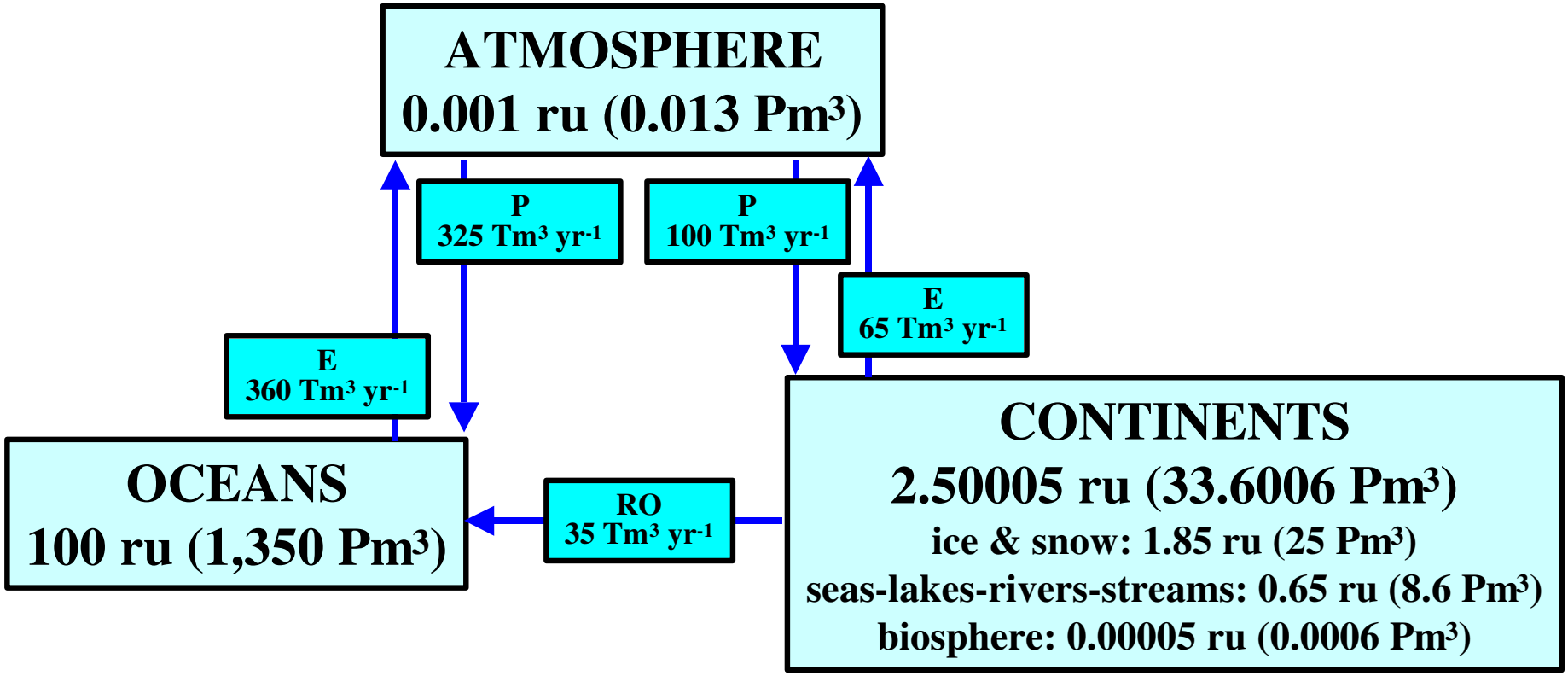
"The Grim Arithmetic of Water"---Official Discussing Emerging Freshwater Crisis---Source: September 2002 National Geographic



Copyright © 2000 *Science*

Global Water Budget

GPM



Notes: (a) global uncertainties order ±25%
(b) transfers some 0.025-0.0025% of ocean reservoir
(c) ru ≡ relative units

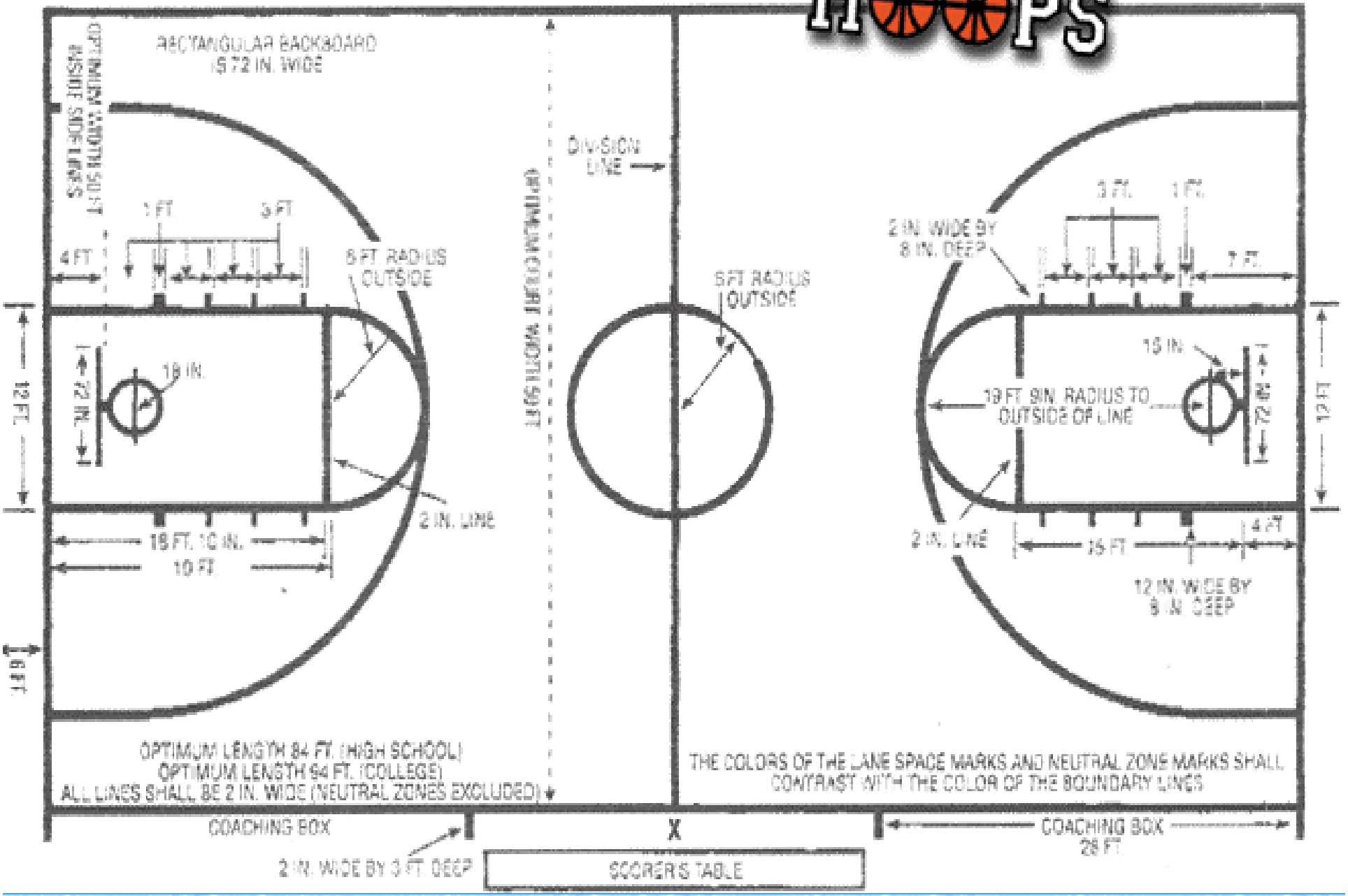
Why Measure Global Precipitation (P) From Space: Can't We Just Use Rain Gauges and Radars?

GPM

Accurate Global Precipitation Estimates are needed for Research and Societal Application Needs (e.g. improved forecasts, water budget closure, climate change assessment, water resources, etc.) Yet:

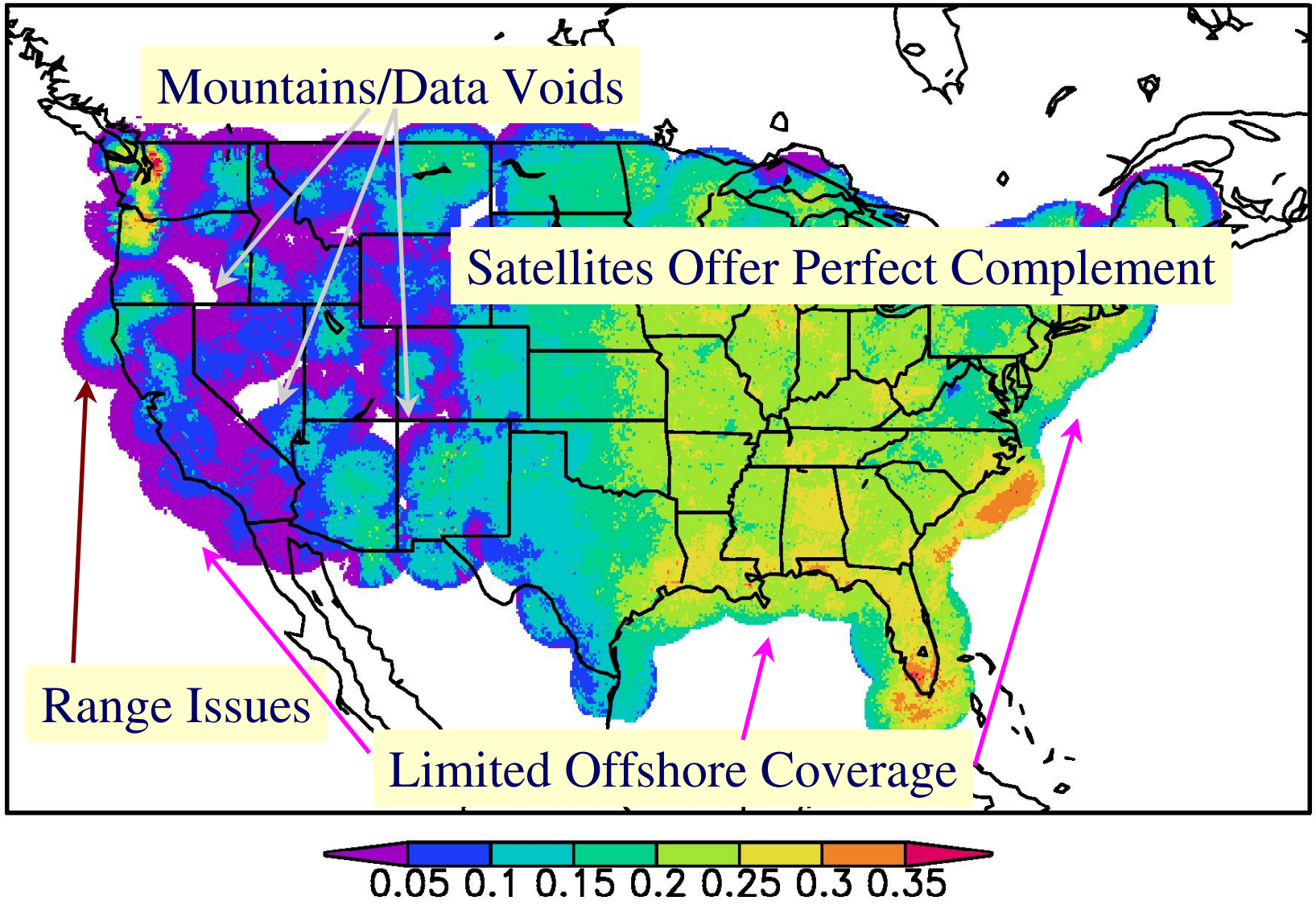
- Rain Gauges are Point Source Measurements of Highly Stochastic Temporal and Spatial Process.
- Rain Gauges experience systematic measuring errors caused by undercatch due to wind drift, evaporation losses, gauge contamination from foreign sources (e.g. bird drops, leaves) and funnel wetting.
- Indirect relationships and climatological variance of Z-R Relationships, Beam Blockage, Clutter Contamination, Beam Broadening and Anomalous Propagation create error for radar estimates.
- 70.9% of Earth's Surface Area is Covered by Water. Of the 29.1% Land-Covered--A Large Percentage is Inaccessible for Gauges or Radars
  - GPCC estimates that 5-20 rain gauges are required per 2.5 degree latitude box to meet the 10% criterion for the relative sampling error on monthly precipitation (Rudolf et al. 1994). As of 1998, there were approximately 2 rain gauges per 2.5 degree latitude box.

Basketball HOOPS



U.S. WSR-88D Frequency of Rainfall Occurrence for 1998 - 2000

GPM

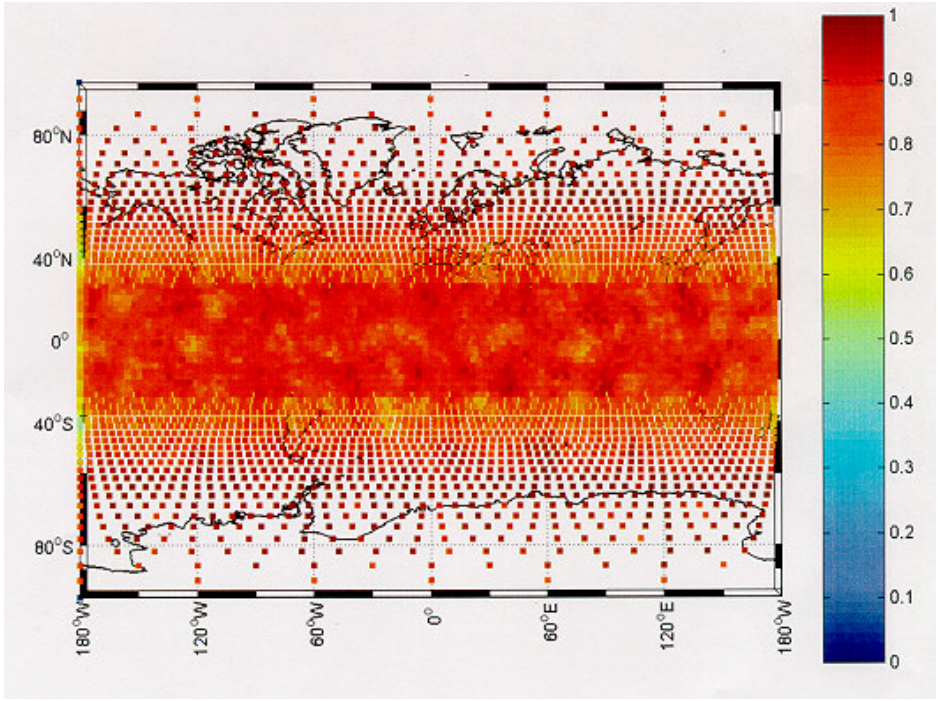


Percentage of 3-Hour Intervals Sampled in 7-Day Period

GPM

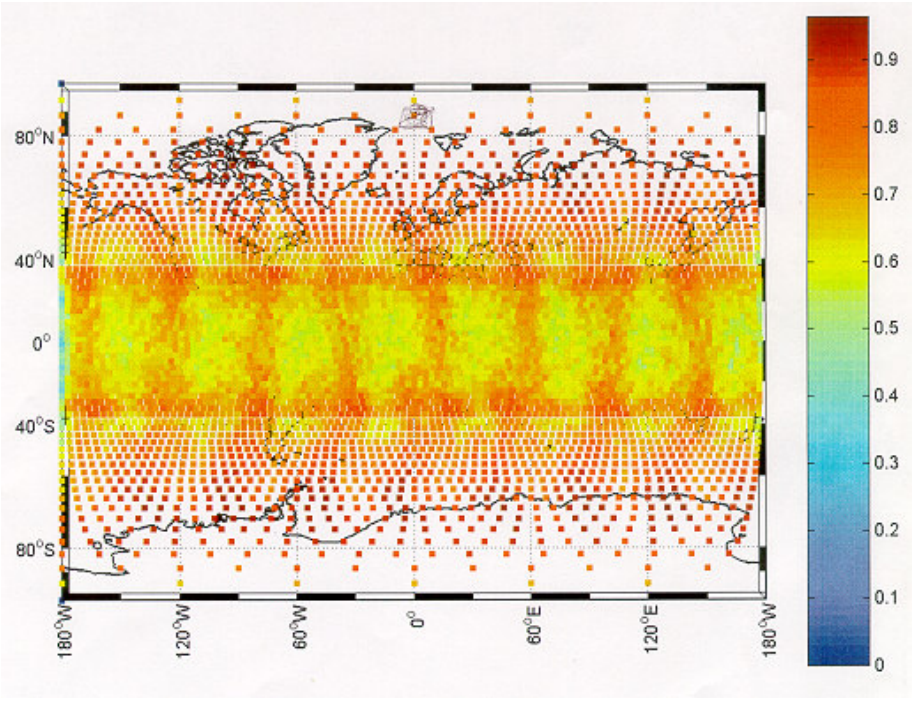
Precipitation Sampling Worldwide: ***Constant Area Pixels***

GPM Era



GPM Core, DMSP-F18 & -F19, GCOM-B1, Megha-Tropiques, & 3 600-km Drones

Currently or Near-Term

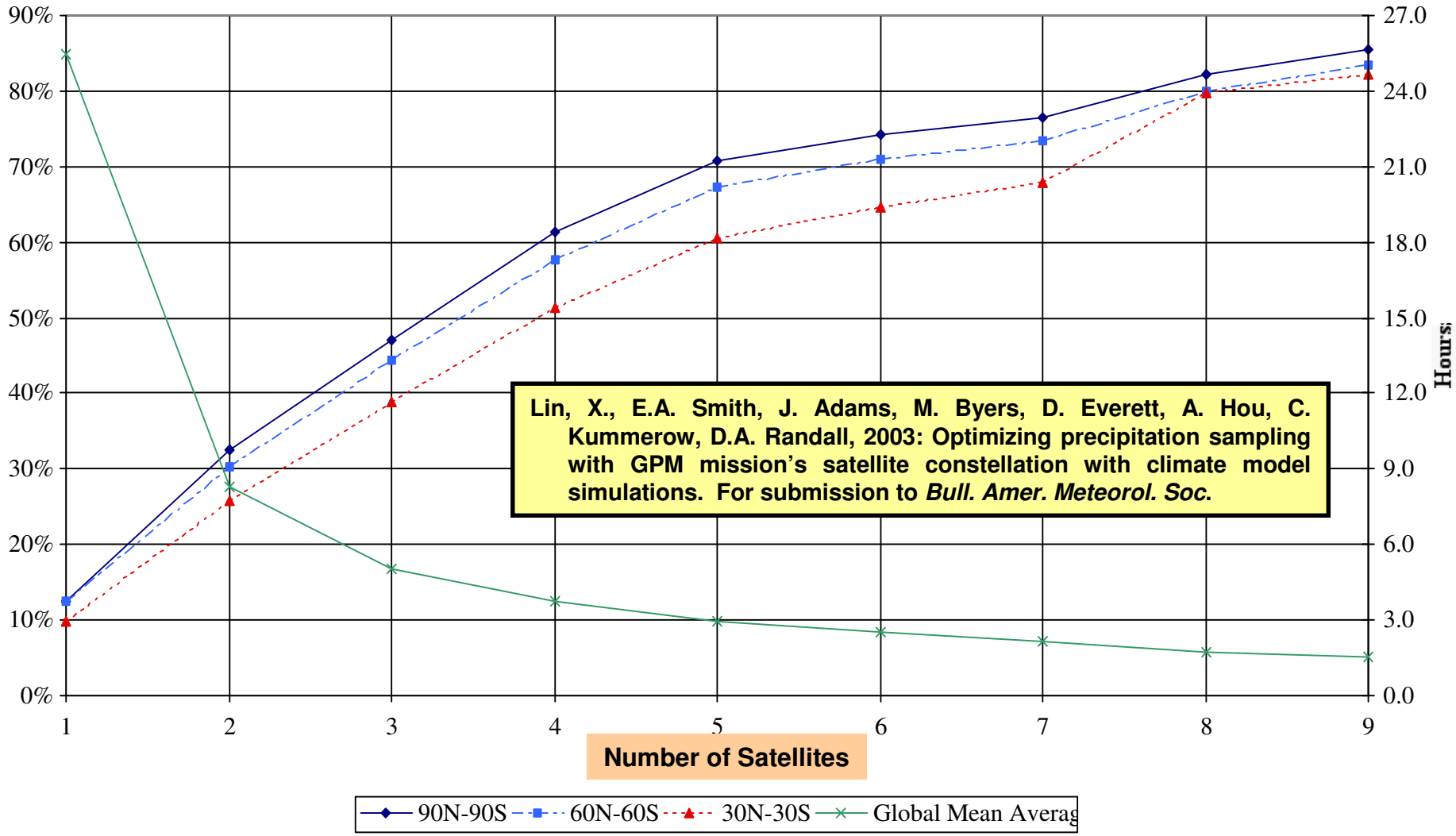


TRMM, DMSP-F13, -F14, & -F15, Aqua, & ADEOS-II

Percent Sampling of 3-Hr Bins & Global Mean Revisit Time

GPM

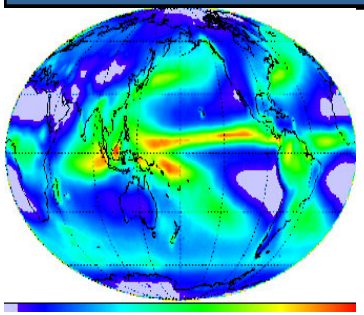
CORE DMSP/F18 DMSP/F19 NPOESS/Lite GCOM-B1 NGPM EGPM MEGHA-TROPIQUES FY-3



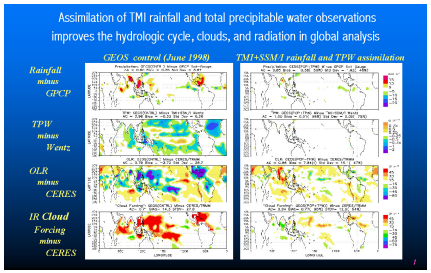
Lin, X., E.A. Smith, J. Adams, M. Byers, D. Everett, A. Hou, C. Kummerow, D.A. Randall, 2003: Optimizing precipitation sampling with GPM mission's satellite constellation with climate model simulations. For submission to *Bull. Amer. Meteorol. Soc.*

From Precipitation Retrieval to Improved Weather Prediction

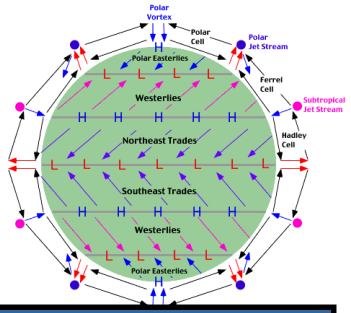
through more accurate & precise measurements of instantaneous rainrates & better methods of rainfall data assimilation



Models Need to Assimilate Both Precipitation Obs & Errors

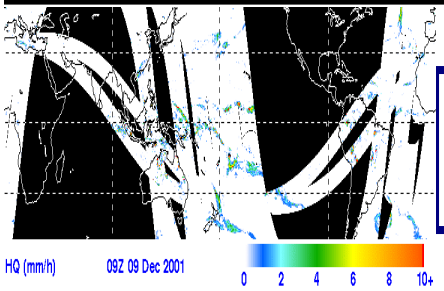


Improved Weather Prediction

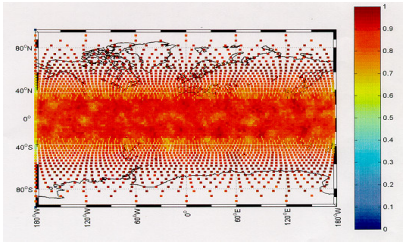


From Precipitation Accumulation to Improved Hydrological Prediction

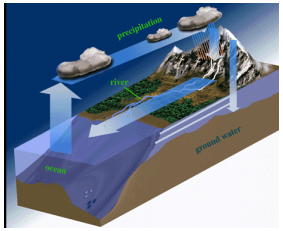
through more frequent sampling & full global coverage of mw precipitation measurements



From Intermittent Tropical MW Sampling to 3-Hour Global Coverage

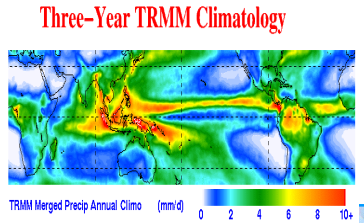


Improved Flood Hazard & Water Resources Prediction

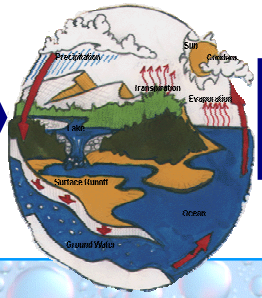


From Precipitation Climatology to Improved Climate Prediction

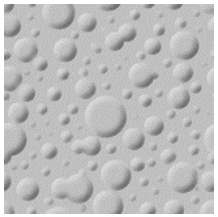
through better closure of water budget & accompanying quantification of accelerations/decelerations in atmospheric & surface branches of water cycle



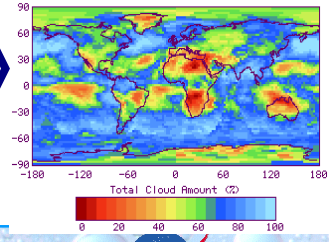
Quantify Storages & Fluxes



Incorporating Microphysics



Improved Climate Prediction



NASA

GPM Science Objectives Have Roots Traceable to NASA Earth Science Enterprise Research Strategy

GPM

I. How is global Earth system changing? (Variability)
- How are global precip, evap, & water cycling changing?

II. What are primary forcings of Earth system? (Forcing)

III. How does Earth system respond to natural & human-induced changes? (Response)
- What are effects of clouds & surf hydrology on climate?

IV. What are consequences of change in Earth system for civilization? (Consequences)
- How are variations in local weather, precipitation & water resources related to global climate variation?

V. How well can we predict future changes in the Earth system? (Prediction)
- How can weather forecast duration & reliability be improved by new space obs, data assim, & modeling?
- How well can transient climate variations be understood & predicted?
- How well can long-term climatic trends be assessed & predicted?